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ABSTRACT

First, the author discusses a major issue, that of school size within the context of the existing theory of scalar economies. He describes expenditures per student for the school as a function of the quality of educational services provided by the school and the number of students in the school. He reviews some studies that considered the impact of school size on various aspects of school quality -- where school quality is defined as some weighted combination of school outputs. The author finds school size to have negative or no impact on achievement test scores and negative effect on a selected set of affective outcomes. Examination of the data on difference in school size between public and private schools reveals that public schools may be too large to operate at the minimum level of expenditure required for a given level of quality. Another major issue discussed concerns the implications of the theory and evidence of school size for educational voucher plans. The author suggests that pressures of competition would encourage firms to operate within the range of optimal school size. Since the minimum efficient size of a school would be relatively small, he suggests that potential competition would also be a real force in the market. The essence of this discussion is that the smaller the size of each individual school in the market for educational services, the greater the number of schools, the extent of competition, and, hence, the efficiency with which educational services will be produced. (Author/JF)

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AN ANALYSIS OF SCHOOL SIZE UNDER A VOUCHER SYSTEM

by

Jay Chambers

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The purpose of these occasional papers is to reflect research findings on the economics and politics of education. The views expressed in each paper are those of the author alone and do not necessarily represent the views of the agency that has supported the research. Additional copies of papers -- if available -- can be obtained from Professor Henry M. Levin, School of Education.

AN ANALYSIS OF SCHOOL SIZE UNDER A VOUCHER SYSTEM

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I. - INTRODUCTION

In the past few years a voluminous literature has arisen about educational vouchers. There have been numerous specific proposals from such people as Milton Friedman, Christopher Jencks, and John Coons to mention just a few.[1] All of the plans follow the same basic structure. The state provides a voucher for each child which can be exchanged for educational services at any school which is approved by the state. Some of the aspects which differentiate the various proposals include the range of schools eligible to receive the vouchers, the determination of the value of the voucher to be given to each child, the restrictions placed upon the tuition charges by schools (i.e., whether or not schools would be required to accept the voucher in full payment for tuition), and various legal restrictions with respect to admission standards.

Two of the prime objectives of a voucher scheme are the promotion of greater educational choice and the promotion of more efficient operation of schools. Under a voucher approach, these objectives are complementary in that consumer choice and efficiency of school operation are both enhanced by a market within which we would find a large number of competing schools. Obviously, the greater the number of schools within a particular market for education, the greater the opportunity

the consumer will have in finding a school to his liking. Furthermore, the greater the number of schools there are within a particular area, the greater the intensity of competition. Based upon the microeconomic theory of the firm, we would predict that the greater the competition between schools, the more likely it is that these schools will approach the ideal of efficient operation.[2]

It is within this context that we are interested in school size. Specifically, there are two criteria which determine the number of firms (e.g., schools) in a particular market (i.e., the market for educational services). On the supply side of the market, there is the "optimal size" of the firm (or school). On the demand side of the market, there is the extent or size of the market in terms of the number of potential buyers of the firm's product (e.g., educational services). It is precisely the relationship between market size and "optimal" school size which determines the extent of consumer choice and the intensity of competition in the market for educational services.

This paper will focus on the supply side of the market for educational services. We will begin with a discussion of the concept of economies of scale. This will encompass a brief review of the theory of economies of scale as it is presented within the general economic literature and it will apply this theory to the operation of the individual school.

Following this theoretical exposition, we will present some evidence relating to economies of scale in school operation. Two sources of evidence will be examined. First, we will review a number of studies which deal with the effects of school size on the quality of

educational services where quality refers to both the cognitive as well as the affective outcomes of the educational process. Second, we will examine some data which compare the sizes of public and private schools. Within this context we will offer an explanation of the observed differences in school size (the public school tending to operate at a larger size than its private school counterpart) in terms of the theory developed in Section III of this paper.

Finally, we will discuss the implications of the theory and the evidence on school size for educational voucher systems. Two issues will be considered in this section. First, we will consider the motivations of educational managers to operate schools efficiently and therefore to operate within the range of "optimum" school size. Second, we will discuss some alternative ways of reducing the minimum efficient size of a school.

Before we proceed with the main body of this paper, let us first clarify what we mean by "school size" and "market size". School size will be simply defined as the number of students who attend a particular school. This variable will be used to reflect the scale of school operation.

The market size for a school is defined as the number of children of a specific age group (i.e., the age group corresponding to the grade levels offered by the school) living within a radius around the school within which the children could reasonably be expected to have access to the school.[3] That is, the school would view this radius as defining the physical access of students to the school in terms of the available modes of transportation. With this in mind, we can see that there

are at least four determinants of market size: (1) the population density of the area and the distribution of children by age group, (2) the availability of efficient transportation facilities, (3) the age group of the children attending the school in the sense that older children have greater numbers of alternatives with respect to transportation, and (4) parent preferences for neighborhood schools.[4]

II. - THE THEORY OF FIRM SIZE AND ECONOMIES OF SCALE

There is a substantial general literature in economics on the relation between the size of the firm and economies of scale. Within the context of the theory of the firm, the economist generally contends that as the scale of operation of the firm increases (i.e., as the firm increases its level of output) from the smallest possible plant, the firm enjoys certain reductions in unit costs related to the size of his plant. These cost reductions are attributable to three important factors: (1) the specialization and division of labor across various tasks, (2) the use of specialized capital equipment including equipment available only in large minimum sizes, and (3) the specialization of management and supervisory personnel with respect to the task of organizing the resources of the firm.

By expanding plant size, the entreprenuer may find it possible to divide various jobs among individual workers rather than have one worker do several jobs as was the case at the smaller scale of operation. There are a number of cost savings implied. First, unproductive worker time will decline because of the reduction in time or effort

allocated to changing from task to task. Second, the worker will have more time in which to learn the intricacies of one job and therefore to perform his job more efficiently. Finally, such specialization permits that workers will have a greater likelihood of being matched to the jobs for which they have the greatest competency. These cost savings apply equally well for managers and supervisors, the only difference being in the nature of the tasks--workers being involved directly in the production process while managers and supervisors are involved in organizational tasks.

The expansion of plant size ma also allow the entreprenuer to change the technology with which he accomplishes certain tasks. There are two considerations involved here. First, expansion will involve the purchase of capital with greater capacity. Generally, a piece of capital equipment that has twice the capacity of another piece of equipment does not cost twice as much as the smaller one nor does it require twice the building space or twice the labor to work with it. Second, expansion may make it worth the expense to invest in equipment which is available only in large minimum sizes to replace a less efficient smaller piece of capital or to replace either productive or administrative personnel through the automation of various tasks which they previously performed.

As the firm continues to expand, the associated reductions in unit costs become smaller and smaller until at some point they disappear.[5] After this point, we have three alternative possibilities. First, the firm may enjoy constant returns to scale as output expands beyond that point. That is, the unit costs remain constant for any level

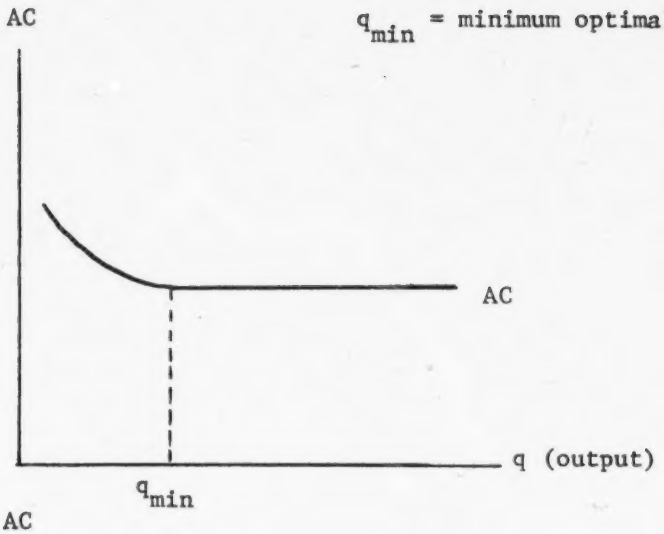
of output beyond q_{min} shown in figure 1-1. Second, the firm may enjoy constant unit costs only up to some point after which plant expansion results in diseconomies of scale and increasing unit costs. This phenomenon usually results from increases in the costs of distribution (i.e., increases in unit costs of transportation due to the centralization of production at one location rather than dispersion of production among several locations) and/or rises in unit costs associated with increases in the difficulty managers encounter in organizing the resources of the firm. This case is shown in figure 1-2. Third, the firm may encounter diseconomies of scale immediately upon expanding beyond the level of q_{min}. This case is shown in figure 1-3, and it represents the classical situation upon which economists base the theory of optimum firm size in a perfectly competitive industry. The individual firm may not only enjoy economies of scale by expanding the operations of a single plant, but it may also be able to reduce unit costs of production by expanding the number of plants in operation. These economies of multiplant operation can result from three sources: (1) economies of large scale management through the centralization and coordination of the operations at the individual plants, (2) the economies of large scale distribution (through reduction in transportation costs), and (3) pecuniary economies of large scale purchases from suppliers.

Several studies have attempted to measure economies of scale among various industries. For example, Bain examined the data for 20 manufacturing industries. He presented his findings in terms of the percent of the relevant market (taking into account the extent or size of the

q_{min} = minimum optimal firm size

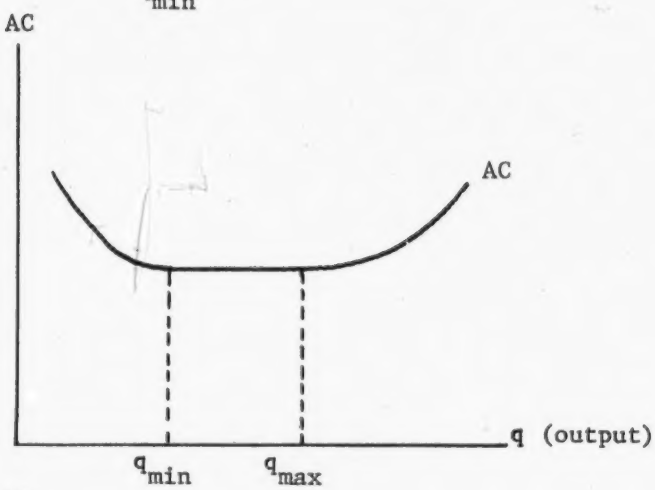
(Average or unit costs)

(Fig. 1-1)



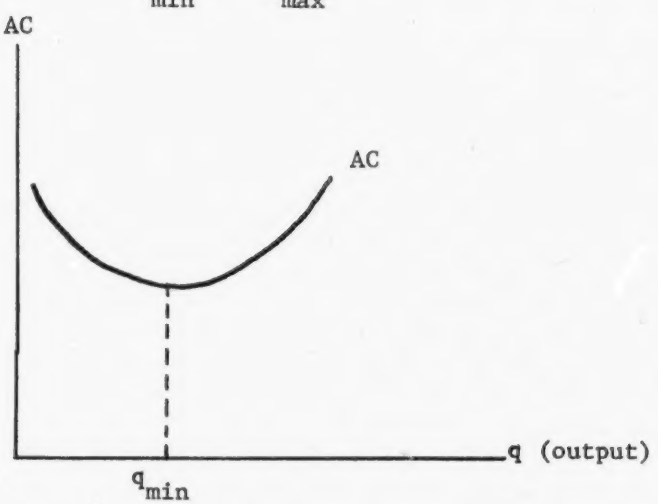
(Average or unit costs)

(Fig. 1-2)



(Average or unit costs)

(Fig. 1-3)



market) contained in one "optimal" plant (i.e., q_{min} in figures 1-1, 1-2, and 1-3). He summarizes his results as follows:

> In some industries, the output of a minimum optimal-scale plant will supply a fairly large fraction of the market faced by the industry. For example, in automobile production a single integrated plant complex of minimum optimal-scale will probably supply as much as 10 per cent of all passenger-car output for the American market. In other industries, the percentage of industry output supplied by a single optimal plant will be more modest (for example, about 5 per cent in the case of cigarettes), and in still others, the percentage will be quite small (for example, 1 per cent or less in the manufacture of shoes or of flour).[6]

Bain also found evidence of the existence of multi-plant economies in some of the industries studied. One final result of interest was his finding that evidence on diseconomies of scale was not apparent or at least that none of the firms studied in his sample were large enough to have shown such effects. This leaves us in doubt as to whether figure 1-1 or 1-2 describes these industries best.[7]

III. - THE THEORY OF SCHOOL SIZE AND ECONOMIES OF SCALE

We turn now to an application of the theory discussed in the previous section. Specifically, we will deal with the economic determinants of school size. Within this context we must consider the importance of defining the outputs or objectives of the school, since such "output" is multidimensional. It is also obvious that we must look beyond the simple relationship between expenditures per student and the number of students as a reflection of economies of scale.

Clearly, the notion of efficiency or economies of scale is meaningless until educational outputs or objectives have been properly

defined. In theory we should examine each of the outputs or objectives of schools, the interaction of these outputs or objectives with each other, and the impact of the scale of school operation on each of the outputs or objectives. If we could then weight their importance, we could proceed to determine the effect of school size on the overall quality of the educational services offered by the school. We are assuming that given market incentives, educational firms will become aware of the impact of school size on the quality of education; and that under the pressure of market competition, educational firms will tend to operate at a scale which offers them the greatest economies (i.e., at least at a scale which is consistent with the most efficient use of educational resources in producing quality education).

There are two basic types of educational outputs to consider. First, there are the quantifiable outputs such as achievement test scores which reflect the development of cognitive skills that have been acquired by the child. Second, there are the other psychological and behavioral outputs such as the values, satisfactions, aspirations, expectations, and other attitudes of students.

In theory the school must examine the interaction of all of these outputs and the effects of school size on the efficient provision of cognitive, attitudinal and other behavioral outputs. It has also been suggested that the composition of students according to various socioeconomic and background characteristics must be taken into account in the choice of the educational technology or philosophy to be employed by the school. The output of the school is not students, but students who have acquired certain levels of competency, ideas, levels

of creativity, values, and behavioral traits. If we measure the ability of the school to instill these things into their students, then we might denote that as the quality of the school. Therefore, in looking at economies of scale of the school, it is the relationship of expenditures per student as a function of the number of students and the quality of the school in which we are most interested.

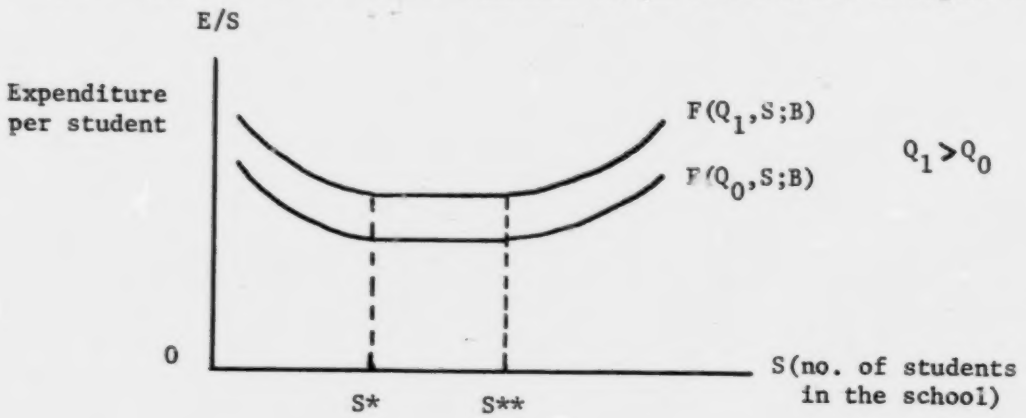
Mathematically, we may write these relationships in the following way:

$$\frac{E}{S} = F(Q,S;B) \text{ , where } F_Q > 0. \qquad (1)$$

with $$Q = G(X,S;B) \text{ , where } Q_X > 0. \qquad (2)$$

E = total expenditures of the school.
S = the number of students attending the school.
Q = an index of the overall quality of the school.
X = a vector of school inputs employed per student in the school.
B = a vector of socioeconomic and background characteristics of the students in the school.

Graphically, we can illustrate equation (1) as shown below in figure 2-1.



(figure 2-1)

Holding Q constant we have postulated a U-shaped curve for the E/S function. This curve is analogous to the U-shaped curves shown in

figures 1-2, and 1-3. We obtain an upward shift of the E/S curve if quality increases from Q_0 to Q_1, where Q_0 and Q_1 are two arbitrarily chosen levels of quality such that $Q_1 > Q_0$.

Let us further postulate that after some level of school size and for a given level of school inputs per student (i.e., X_0), quality of educational services offered by the school begin to fall as size continues to increase. We may express this relationship mathematically in the following way.

$$G_S < 0 \text{ for } S > S_0. \tag{3}$$

Let us now explore what we mean when we say that the level of school quality falls. The index of quality is made up of a weighted combination of the various outputs of the school, e.g., cognitive skills, creativity, certain values, and behavioral traits of the children. To say that the level of quality of the school falls as school size increases implies that the weight (i.e., importance) given to those outputs which are negatively affected by the increase in school size is greater than the weight given to those outputs, if any, which are positively related to school size. For example, it may be that cognitive skills are positively related to school size while all the other outputs are negatively related to school size. If the weighted decrease in all other outputs exceeds the weighted increase in cognitive skills, then we would say that the level of quality of the school has decreased. The reasoning is similar, but in the opposite direction, for a decrease in school quality.

The question now becomes what is the rationale for postulating any such relationship between school size and school quality. Let us

consider two possible explanations for the negative relationship between size and quality of a school implied by equation (3). The first one deals with the increasing difficulty of organizing school resources effectively as the size of the school increases. That is, as school size increases there may be a reduction in the extent of interaction, communication, and the coordination of activities among the children, among the teachers, and between teachers and administrators. Furthermore, as the increasing size of the school makes management more difficult, the school administrator may respond by resorting to various sets of rigid and uniform rules and regulations which may have the effect of stifling initiative and creativity both among teachers and children. Thus, school size becomes an obstacle to the ability of school personnel to organize their resources effectively, and consequently we would expect a negative relationship between size of school and educational outcomes for students.

A second alternative explanation of the negative relationship between size and quality of the school may be derived from the consideration of the possible effects of school size on behavioral and attitudinal outcomes of the educational process. That is, as school size increases, it is possible that each student in the school takes on less importance and becomes more redundant within the ongoing process of education. Two consequences may result from this increase in redundance of each student. First, larger schools may tend to foster fewer satisfactions and a lower sense of self-efficacy of the individual students in the school. This may be more true of those students who do

not consider themselves to be academically inclined. Hence, we have a negative relationship between school size and the affective outcomes of the educational process.

On a second level, these affective outcomes (e.g., student satisfactions and sense of self-efficacy) may tend to have an effect upon a student's achievement test scores. That is, it seems reasonable to expect that students' attitudes toward their environment and toward themselves will affect their ability to acquire cognitive skills. Thus, through its negative effect upon these affective outcomes, increases in school size will also have a negative impact upon student performance on achievement tests.[8]

Let us now proceed to describe the relationship illustrated in figure 2-1 between E/S and S with the level of quality (i.e., Q) held constant. As the school increases from S=0 to S=S*, it is obviously taking advantage of economies of scale. These decreasing costs reflect the fact that the given curriculum and its corresponding resources are being divided among a greater number of students. This might involve a more intensive use of such resources as science laboratory facilities, and teachers can increasingly specialize rather than teach courses for which they lack adequate background.

At S_0 the level of quality, Q, begins to fall as S increases as postulated in equation (3) above. To prevent Q from falling E/S must rise. That is, in order to compensate for the effects of a larger size on Q, we must increase the level of school resources applied to each student, i.e., X, recalling that $G_X > 0$. This requires an increase in E/S. Counteracting this increase in E/S is a decrease resulting

from continued enjoyment of economies of scale with regard to certain other aspects of the production process referred to previously. We are assuming that within the range between S* and S**, these two forces working on E/S exactly offset one another. As S increases beyond S**, however, the increases in E/S required in order to hold Q constant become larger than the decreases in E/S due to the possibility of continued economies of scale. Eventually, the school may run into diseconomies of scale and both forces begin to push upward on the expenditures per student, E/S.

The remainder of this paper will focus on two related aspects. First, what is the evidence on the effects of size (S) upon the quality of the school? Second, which portion of the E/S curve do schools of a given type tend to operate on? Unfortunately, within the context of available evidence, we will be unable to set specific values to S* and S**.

IV. - EVIDENCE ON THE EFFECTS OF SCHOOL SIZE ON SCHOOL QUALITY[9]

Within this section we will divide school quality into two types of educational outputs: cognitive skills and affective characteristics of students. With respect to cognitive skills we will examine the results of some empirical studies on the effects of school size on achievement test scores of students. Within the affective domain of school quality we will present the results of a study of the relationship between school size and the participation and satisfactions of students with respect to school activities.

Effects of School Size on Student Achievement

Very little research has been carried out on the effects of school size and student achievement. Of the three comprehensive studies, two explore high school size and one addresses elementary school size.

Herbert Kiesling, in his study "High School Size and Cost Factors", sought to determine the effects of high school size upon the performance of students on achievement tests (both mathematics and verbal ability tests) while holding a measure of I.Q., school inputs and socioeconomic status of students constant. He found there to be a negative relationship between school quality and school size for schools ranging in size from 200 to 4,000 students. When his data were cross-classified by region of the United States and by the degree of urbanness of the area in which the school was located, he found the size-performance relationship to be negative but statistically insignificant. In contrast, when the data were aggregated over all areas, the size-performance

relationship was significant statistically. Kiesling summarizes his conclusions in the following way.

> . . . (T)here is little evidence in the study that larger high schools are more efficient high schools, while there is considerable evidence that larger high schools are less efficient. In an age of school consolidation, this should serve as at least a word of caution.[10]

In another study of the educational process in large-city high schools, Burkhead, Fox and Holland found there to be no statistically significant relationship between school outputs and school size after holding a number of other inputs constant.[11] The educational outputs used in their study were post high school educational intentions, dropout rates, and test scores (i.e., I.Q. and reading scores in the 11th grade). The sample consisted of schools ranging in size from about 500 to 2,500 students. Thus, within this range of size, Burkhead, et. al., found no economies of scale to be evident.

Stephan Michelson studied the effects of elementary school size upon 6th grade reading scores.[12] The sample of schools which he examined varied in size from 139 to 1,710 students. Although he found there to be a negative relationship between school size and student performance on reading tests, Michelson had to qualify his results since none of the relationships were statistically significant.

Effects of School Size on Affective Educational Outcomes

The previous studies relied primarily on test scores or other similar outputs of the school as a reflection of the quality of education. However, as we suggested above, we must also take into account the affective outcomes of the educational process in order to make any conclusive

statements about economies of scale of the school. That is, even if it were true that large schools could provide more cheaply higher achievement test scores, this gain might come at the sacrifice of some of the other psychological and behavioral attributes which are important aspects of the educational process. The principal difficulty encountered in testing this thesis is that these affective outcomes are not easily measured.

Barker and Gump in their book, Big School, Small School, concentrate on the relationship between high school size and some of these non-quantifiable educational outputs.[13] The schools they examined ranged in size from 35 students to 2,287 students. One of the aspects of education which was considered in their study was the relation between school size and the scope of academic programs. They found that while the largest school had 65 times as many students as the small school, it had only 2.3 times as many kinds of academic activities. In general they found that "the smaller schools were deficient, in comparison with the larger schools, with respect to specialized mathematics, specialized social and behavioral sciences, foreign languages, and specialized business classes."[14] It was discovered that some of the material covered in the specialized courses taught in the large schools was covered to some extent within related courses in small schools. Thus, there was relatively little difference in the richness of the programs between large and small schools when the degrees and the nature of diversity between large and small schools was closely examined. In fact, some of the activities and facilities which are unique to the large school appeared to be somewhat peripheral to school life in that they were established for quite small special groups.

Barker and Gump also examined differences between students in small schools and large schools with respect to their participation in and satisfactions derived from various activities within the schools. They observed that small school students participate and hold responsible and important positions in a wider variety of activities than do students in large schools. Barker and Gump state their case in the following way:

> The educational process is a subtle and delicate one about which we know little, but it surely thrives on participation, enthusiasm, and responsibility. Our findings and our theory posit a negative relationship between school size and individual student participation. What seems to happen is that as schools get larger and settings inevitably become more heavily populated more of the students are less needed; they become superfluous, redundant.[15]

With regard to satisfactions, Barker and Gump make the following statement:

> . . .Juniors from the small schools reported more satisfactions relating to the development of competence, to being challenged, to engaging in important actions, to being involved in group activities, and to achieving moral and cultural values: while large school Juniors reported more satisfactions dealing with vicarious enjoyment, with large entity affiliation, with learning about their school's persons and affairs, and with gaining 'points' via participation.[16]

The participation and satisfaction of a student with various activities may well be considered as important outputs of the educational process. This may be especially true in the case of schools which have large numbers of disadvantaged or "marginal" students (i.e., Barker and Gump define a marginal student as one who is presumably less suited for academic and school life--one who has a tendency to drop-out). In fact, Barker and Gump report that,

> In the small school, marginal characteristics made no difference; marginal students experienced almost as many forces

> toward participation as the nonmarginal students. In the large school, however, the marginal students experience relatively very few attractions and pressures toward participation.[17]

Barker and Gump go on to conclude that,

> A small school is not so small in terms of the number and variety of its behaviorally significant parts as it is in terms of students; like a small engine or small organism, it possesses the essential parts of a large entity, but has fewer replications and differentiations of some of the parts.[18]

Based on the evidence supplied by Barker and Gump, we might conclude that there is a negative relationship between school size and at least some of the affective outcomes of the educational process. In this sense it would seem that the small school has advantages over the large school in producing certain types of competencies and values. To the extent that these educational outcomes are valued, they should be taken into account in deciding on the scale of school operation.

We have examined evidence on two types of educational outcomes within this section: cognitive skills (as reflected in achievement test scores) and a set of affective characteristics of students. Both of these types of outcomes of education are, <u>to some extent</u>, considered to be the responsibility of the process of formal schooling.[19] With regard to the effects of school size on student achievement, we have found evidence of either a negative relationship or no relationship between the two variables. We also found a negative relationship to exist between school size and the set of affective characteristics (i.e., participation and satisfactions) of students. If we can regard these outcomes as measures of school quality, then we can confirm the

negative relationship between school size and school quality (i.e., $Q_S < 0$ for $S > S_0$) which we hypothesized above.

We should emphasize that these conclusions are based upon evidence available given the current "state of the art." No study has attempted to measure the impact of school size upon all of the affective outcomes which might be considered to be important, and none have taken account of the complex interaction of the various educational outputs. There have not yet been undertaken comprehensive studies of the impacts of school size on the entire process of educational production, and the complexities of such an endeavor may be overwhelming. Nevertheless, it is important to note that the available evidence does not support the view that larger schools are generally superior to smaller ones.

V. - ANALYSIS OF SIZE DIFFERENCES BETWEEN PUBLIC AND PRIVATE SCHOOLS

Given the negative relationship between school quality and school size indicated by the evidence in the previous section, and given our assumptions about the shape of the E/S curve illustrated in figure 2, we will now examine some data on schools within the public and private sectors in order to draw some conclusions as to where these schools operate on the E/S curve. Our ultimate goal, however, is to draw the analogy between the operations of private schools in the current market for educational services and the expected operational behavior of all schools under a voucher plan. But we will leave this task for the last section of this paper.

Sizes of Public and Private Schools

The question to which we now address ourselves is what are the relative differences in the sizes at which public and private schools operate. At the most general level, we can compare the average enrollment between the public and private schools for the entire United States. For the public schools in 1968-1969 we found the average level of enrollment to be 490 students per school.[20] The average enrollment for private schools was 300 students per school.[21] Hence, on the average, the private school tends to operate at about 60% of the size of the average public school.

The major difficulty with these data on public and private school size is that they fail to distinguish between the different levels of education. Due to the differences in the goals and objectives and the

resulting variations in the processes of educational production between elementary and secondary schools, it seems more reasonable to separate the data, when possible, by level of education.

Table 4-1 below provides us with a comparison between public and nonpublic (i.e., private) school size by level of education. The results of this comparison indicate that on the average, the public elementary school operates at a size about one-third larger than the private elementary school while the public high school (i.e., secondary school) operates at more than twice the size of the private high school. Even at the higher education level we find that the public institutions tend to operate at larger sizes than do private institutions.

Table 4-1. A Comparison of Sizes of Public and Nonpublic Schools by Levels of Education, 1968-69.[a]

	Public Schools	Nonpublic Schools
Elem.	401	290
Sec.	751	331
Higher Educ.[b]	5,150	1,455

[a]The average school sizes in the table were derived by dividing enrollment by the number of institutions for each level and type of education.
[b]The sizes of schools of higher education are for 1967-68.

Sources: Statistics of Local Public School Systems, Fall 1968, U.S. Department of H.E.W.--Office of Education, p. 4, Table A.
Directory--Nonpublic Elementary and Secondary Day Schools, 1968-69, U.S. Department of H.E.W.--Office of Education, p. 10.
Digest of Educational Statistics, 1969 Edition, U.S. Department of H.E.W.--Office of Education, pp. 7 & 84.

Given this overall impression that the public school tends to be relatively larger than the nonpublic school, we shall now proceed with a case study of school size in the San Francisco Bay Area. The rationale for such a case study is that it allows us to engage in a more detailed analysis which is able to control for a number of factors which are obscured by the national averages in Table 4-1. Specifically, we will be comparing public and private school size in three locations within the San Francisco Bay Area: the city of San Francisco, the city of San Jose, and a suburban area composed of several smaller cities located between San Francisco and San Jose.[22] There are two reasons for choosing these three areas. First, the areas chosen are fairly large and densely populated areas in which the options for school size are not restricted to small schools because of a lack of demand for educational services. Second, the three areas can be examined separately in order to compare the size of public and private schools in the absence of as many extraneous influences on school size as possible (e.g., differences in the composition of the population with respect to religion, racial and ethnic background, socioeconomic class, etc., all of which may have an influence upon the demand for private relative to public education).

In Table 4-2 below we have compared school sizes of private to public elementary schools (i.e., kindergarten through sixth and kindergarten through eighth grades) and private to public secondary schools (i.e., grades nine through twelve). The specific grade levels of the schools being compared are indicated. Note that there are a number of different types of private schools. Within our sample the vast majority of private schools were Roman Catholic (referred to as RC in the table

Table 4-2. A Comparison of School Size Between Nonpublic and Public Schools in the San Francisco Bay Area (1968-69)

Nonpublic Schools		Public Schools	No. of Nonpublic Schools N_1	No. of Public Schools N_2	t-stat.	Level of Significance
Grade levels & Ave. Size (1)	Type (2)	Grade levels & Ave. Size (3)	(4)	(5)	(6)	(7)
SAN FRANCISCO:						
K-6(137)	ALL	K-6(417)	7	31	-5.13	99.5%
K-6(226)	RC	K-6(417)	3	31	-2.38	97.5%
K-6(76)	IND	K-6(417)	3	31	-4.23	99.5%
K-8(392)	RC	K-6(417)	35	31	-0.71	75.0%
9-12(500)	RC	10-12(2,078)	14	10	-7.46	99.5%
SAN JOSE:						
K-8(392)	RC	K-6(513)	12	54	-2.22	97.5%
9-12(599)	RC	9-12(1,884)	4	11	-7.01	99.5%
SUBURBAN AREA:						
K-6(143)	ALL	K-6(355)	6	51	-4.60	99.5%
K-8(345)	RC	K-6(355)	16	51	-0.287	----
K-8(345)	RC	K-8(505)	16	5	-2.53	99.0%
9-12(586)	RC	9-12(1,863)	6	9	-8.35	99.5%
ALL THREE AREAS TOGETHER[b]						
K-6(96)	IND,OR	K-6(432)	9	136	-6.14	99.5%
K-8(137)	IND,OR	K-8(505)	14	5	-9.76	99.5%
9-12(164)	IND,OR	9-12(1,875)	9	20	-15.91	99.5%

[a]When nonpublic school sizes and public school sizes are being compared, the numbers of kindergarten children are not included. For example, only children in grades one to six are included in K-6 schools. This assumes that the kindergartens are to some extent isolated from the rest of the school. Generally, they have different hours of attendance and separate playgrounds. Hence, they are not regarded as part of the relevant measure of school size. We might look at the K-6 school as really two schools sharing a single site: one school for grades one to six, the other for kindergarten.

(Table 4-2 continued on page 25)

below). The balance was made up of independent private schools and other religious schools (e.g., Luthern, Episcopalian, Seventh Day Adventist, Jewish). These will be labeled as IND and OR respectively. When all private schools are taken together we will indicate this by ALL in the table below. We used the t-statistic to test the significance of the difference between the means of samples of private versus public schools with respect to school size.[23]

Analysis of the Data

The negative and statistically significant t-statistics presented in Table 4-2 indicate that private schools tend to operate consistently at smaller sizes than do public schools offering a similar range of grade levels. In fact, within our sample we find that the nonpublic elementary schools tend to operate within a range of about 40% to 80% of the size of comparable public elementary schools. Furthermore, nonpublic secondary or high schools operate at about one-fourth to one-third the size of the public high school. One of the implications of these results is that within the private market for educational services established by the educational voucher plans, we might expect to find almost twice as many elementary schools and 3 to 4 times as many high schools from which parents can choose to send their children.

(Continuation of Table 4-2)

[b]Because of the small sample of independent (IND) and other religious (OR) private schools in each of the three areas, we combined the three areas together for comparison of public school size and private independent and other religious school size.

Sources: The directories for Public Elementary and Secondary Day Schools and Nonpublic Elementary and Secondary Day Schools, from the U.S. Department of H.E.W.--Office of Education, National Center for Educational Statistics, Volumes IV and V, respectively.

There are two factors which operate to determine the size of the private or nonpublic school: (1) the extent of market demand for educational services provided by private schools and (2) the "optimal size" of the school with respect to the technical considerations of the supply of educational services. We might argue that private school size may be limited by the extent of the market for private educational services. That is, since parents already pay taxes to support the public school systems, they are either reluctant or unable to afford to lay out extra expenditures in order to send their children to private schools. Hence, to the extent that this is the case, the demand for private school education is lower in any specific area than the demand for public school operation and than would be true under a voucher arrangement. Any observed size differences between private and public schools, then, may possibly be attributable to the limits of the market for private education.

Alternatively we may argue that some private schools, especially those which we might classify as very exclusive and prestigous, have waiting lists of students and yet still continue to maintain their limited scale of operation. To clarify this argument we can draw an analogy between the markets for private pre-school and higher education and the market for private elementary and secondary education. In a survey of the pre-schools in the San Francisco Bay Area, it was discovered that 66% of these private pre-schools had waiting lists of students and yet only 19% had any plans to expand their scales of operation.[24] Similarly, we find that many private institutions of higher education, especially the older and more prestigous institutions, maintain their scales of operation despite a substantial excess demand for the educational

services which they offer. We are suggesting that in many instances the small sizes of the private schools are not caused by the limits of demand. Specifically, these private schools may be trying to preserve the nature of the educational services which they offer. That is, they have already reached their optimum size of operation and simply do not desire to expand.

Roman Catholic schools are probably less subject to the limits of market demand for the educational services they supply than are other nonpublic schools. The reason for this is that parish or diocesan subsidies help to reduce the levels of tuition charges for Catholic schools to a minimum. A recent report on U.S. Catholic schools makes the following statement with regard to subsidies:

> The concept and practice of parish subsidy has made the Catholic parish school into something of a Catholic "public" school which serves all Catholic families in the parish regardless of their income. Parish or diocesan subsidies have had somewhat the same effect on the parish or diocesan supported high schools. In the Catholic private schools, where tuition charges tend to make family income more of a selection factor, support from the religious communities, that own and operate these schools, often enables less affluent students to attend.[25]

In a study on the demand for Catholic schools, Bartell refers specifically to the effect of price (or tuition) on enrollment in Catholic schools.

> Because of the low tuition rates associated with traditional objectives of Catholic education . . ., especially at the elementary level, the price variable has proven insignificant in our most extensive study to date, suggesting the likelihood that substantial increases in user costs will not be a serious deterent to enrollment.[26]

In essence, the data suggest that the explanation for these size differences is on the supply-side of the market. That is, the Roman Catholic school administrators may find that they can operate their schools either more efficiently or at least as efficiently, in terms of their educational goals and objectives, at a smaller scale of operation than that of the average public school. The implication of this statement is simply that the minimum "efficient" size of a school may in fact be smaller than that at which the average public school operates. In terms of the E/S curve in figure 2, the average Catholic school may be operating at a level greater than or equal to S* whereas the public school operates at an even larger scale, for example, either between S* and S** or somewhere beyond S**.

Let us pursue this argument in greater depth. There is evidence to indicate that the Catholic school operates at a level of quality which is comparable to that of the public school. Bartell, in his study of the costs and benefits of Catholic education, found eigth grade test scores of pupils in Catholic schools in Youngstown, Ohio to be "up to 13 months beyond national norms for the level of performance expected of pupils in the second month of their eigth grade."[27] Bartell goes on to qualify his results.

> The fact that IQ scores are relatively high despite an explicit policy of discouraging academic ability as a criterion for rationing available school places suggests that the population from which the parochial schools draw is not completely comparable with the population in the community at large.[28]

Given this qualification, we would have to adjust the number of months by which Catholic pupils out-scored pupils in public schools in some

manner to compensate for the differences caused by the different composition of students.

Further evidence on the quality of Catholic education is provided by James Morrison and Benjamin Hodgkins.[29] Their conclusions are summarized in the following way:

> Defining 'effectiveness' as the proportion of former tenth grade students in senior high schools who go on to any form of post-secondary education, controlling for the number of dropouts, the results of the analysis indicate that Catholic senior high schools are more effective than public senior high schools. This difference was maintained even when the effects of the capability of the student body, the social class context, and the community setting were controlled for.[30]

Moreover, the fact that the Catholic school tends to operate at a smaller scale than the public school suggests, according to the analysis of Barker and Gump, that the Catholic school operates at a higher level of quality. That is, the smaller school size implies a higher level of affective educational outcomes and everything else equal (i.e., all other school inputs equal) this implies a higher level of quality.

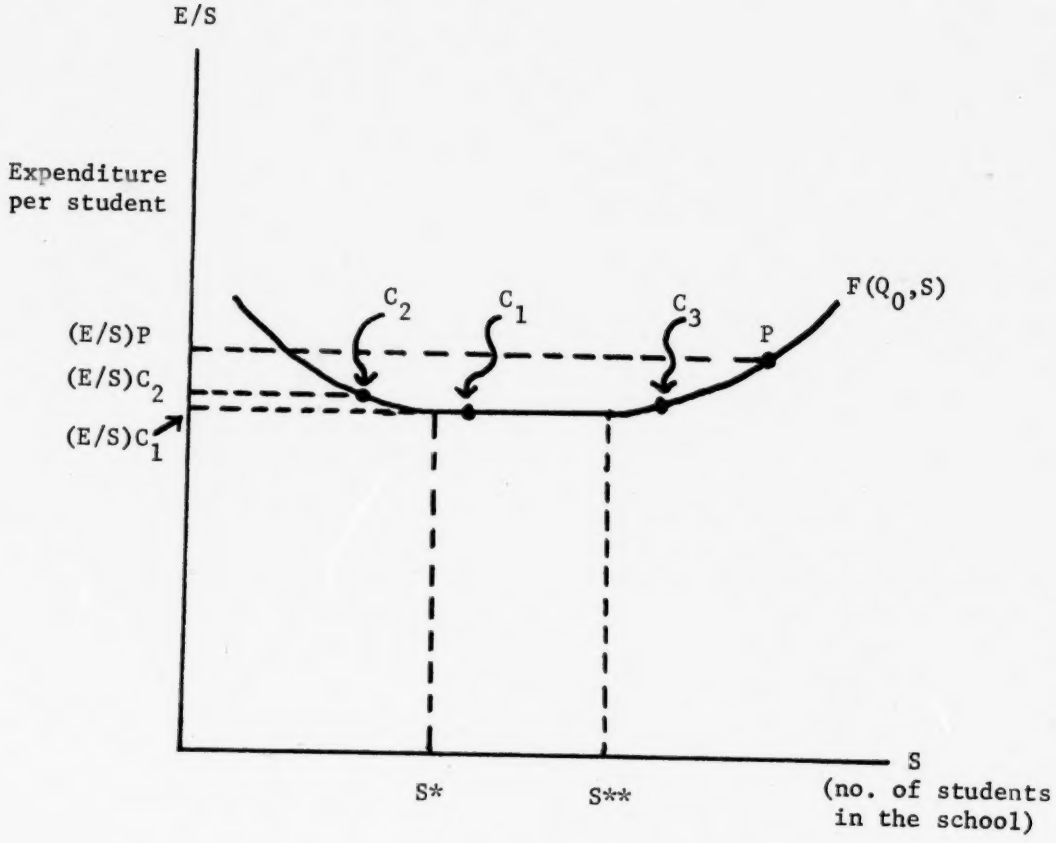
But, everything else is not equal. Catholic schools tend to have higher ratios of pupils to teachers (and larger class sizes) than public schools at both the elementary and secondary levels.[31] Furthermore, teachers in the Catholic schools tend to have a lower level of educational preparation than do teachers in public schools.[32] Thus, with lower levels of these resources available to Catholic students, we would expect to find a lower level of educational quality for any school size. However, this conclusion is not made with much conviction in light of the studies of educational production functions which indicate

that such inputs as teacher's educational preparation (i.e., degree level and whether or not the teacher possesses a teaching certificate) and class sizes (at least within the ranges studied) do not appear to be related to student performance on achievement tests.[33]

In order to see the relevance of the discussion on school quality to the issue of economies of scale it is useful to refer again to figure 2-1. From this figure we note that there are two pieces of information with which we are concerned: expenditures per student (E/S) and the level of quality of educational services of the school. While it is difficult to draw any final conclusions with respect to the relative quality of Catholic versus public education on the basis of the evidence presented above, it seems reasonable to assume that Catholic schools and public schools operate at approximately the same level of quality (i.e., they are equally effective in terms of the weighted combination of educational outcomes). This implies that the Catholic and public schools are both operating on the same E/S curve in figure 2. For the purpose of this exposition, let us suppose that the level of quality of both types of schools is equal to Q_0 and illustrate the corresponding E/S curve on the graph in figure 4-1.

Given that the two types of schools (i.e., Catholic and public) are on this E/S curve, we know that the Catholic school will tend to lie to the left of the public school in light of the evidence on school sizes presented in Table 4-2. But we need data on relative expenditures in order to specify in which part of the curve we expect these schools to be operating. Evidence indicates that Catholic schools tend to spend

COMPARISON OF CATHOLIC AND PUBLIC SCHOOL SIZE



(Figure 4-1)

less per student than public schools. This is true even when expenditures of the Catholic school are augmented by the value of "contributed services" (i.e., "the value of the services of personnel and physical resources for which no cash charge is made in parish accounts"--for example, the services of religious personnel to the school).[34]

Based on differences in expenditures and our assumptions about the relative quality of Catholic and public schools, we can posit that the public school will tend to operate in the region beyond S** on the E/S curve and suffer from diseconomies of scale due to excessive size.

To illustrate, let the letter P represent the typical public school, and let C_1, C_2 and C_3 represent the possible Catholic schools. Catholic school C_1 operates in the range of minimum cost (i.e., minimum E/S) in figure 4-1. However, it is possible that the typical Catholic school could be operating at point C_2 in the region below S* or C_3 in the region above S* in figure 4-1. In all of these cases the scale of operation of the Catholic school is more efficient than that of the public school at P.

In summary, the evidence suggests that Roman Catholic school administrators have responded to considerations of the supply-side of the market for education by providing a quality of educational services similar to that of the public school but at a relatively smaller size and relatively lower expenditure per student.

Some Factors Which Affect Public School Size

One of the factors which affects the size of the public school is its relationship to and location in the local public school system. The

public school district is analogous to the multiplant firm in that it usually operates a number of schools. Furthermore, the existence of the school district can be rationalized in the same way as the existence of the multiplant firm; that is, on the basis of economies of multiplant operation which we discussed in the first section of this paper. To reiterate, these economies involve three things: (1) economies of large scale management through the centralization and coordination of the operations at the individual plants or schools in this case, (2) the economies of large scale distribution which for the school district might involve a more intensive use of transportation facilities for busing children, and (3) pecuniary economies of large scale buying from suppliers.

The question that we wish to raise is at what point does the size of the school district affect the overall quality of educational services. It is this question of district size and its relationship to school size which is particularly pertinent.

The management of a school system requires a well coordinated effort between schools at different sequential levels and between age-grade levels within schools. Furthermore, there is "the necessity for outcomes which are uniform with respect to a minimum standard."[35] The rationale for this uniformity is that in order to assess the success of the system, there must exist some set of uniform standards of student accomplishment.

Despite these requirements of coordination and uniformity, individual schools and teachers within the system are relatively autonomous in terms of certain discretionary powers concerning various procedures (e.g., the specific classroom methodology of instruction). Charles Bidwell refers

to this autonomy as "structural looseness." Bidwell describes the conflict which arises.

> (B)oth the looseness of system structures and the nature of the teaching task seem to press for a professional mode of school-system organization, while demands for uniformity of product and the long time span over which cohorts of students are trained press for rationalization of activities and thus for a bureaucratic basis of organization.[36]

It is obvious that the management of such a system is very complex. Therefore, school systems are, to some degree, bureaucratic. That is, there is a functional division of labor, a hierarchic ordering of offices, and much of the operation is based upon rules of procedure.[37]

But how does all of this affect school size? It might be suggested that the larger the school system becomes the greater is the difficulty of monitoring and controlling the operations and outcomes of the individual units within the system. The hypothesis we are suggesting is that as the system becomes larger and begins to run into these increasing difficulties of large-scale management, the central administration responds by increasing the size and reducing the number of individual units operating within the system. For the school district this implies an increase in school size. The result is that the school district administrators trade off the level of school quality in order to maintain their ability to control and influence the operations of all of the individual units within the system.

But why would the district administrator be willing to sacrifice school quality? There are at least three possible reasons. First, it is difficult to measure and assess changes in the quality of the educational process. Second, public school information systems are generally

inadequate for making even approximate measurements and assessments of such changes in school quality. These first two reasons combine to imply that efficiency considerations become relatively unimportant since they tend to be difficult to assess. Third, because of the incentive structure of the public school system, there is little motivation to the educational administrator to put forth any effort to make such assessments.[38] In fact, because of visibility of the administrator's behavior, his ability to govern and control the system becomes a higher priority. The ultimate result of these three factors is that the school administrator tends to place social control above educational consequences.

As we examine the data in Table 4-3 below, we notice that average school size (both elementary and secondary) increases rather dramatically as the size of the school district increases. This phenomena may be due partly to the greater ability of larger school districts to take advantage of the economies of scale in school operation although such economies are largely undocumented. However, these data are consistent with our hypothesis that district administrators tend to trade-off the level of quality of educational services provided by each school in order to reduce the difficulties associated with control of the operations of each school.

Table 4-3. Statistics on School Size in Local Public School Systems in the United States by Enrollment Size Fall, 1967[39]

Item	Enrollment Size of School District					
	25,000 or more	10,000 to 24,999	5,000 to 9,999	2,500 to 4,999	300 to 2,499	Under 300
Percent of total no. of school systems	0.9%	2.6%	5.6%	10.1%	39.4%	41.4%
Percent of total enroll.	28.5%	17.3%	16.9%	15.7%	19.7%	1.9%
Ave. no. of pupils per school						
Elem.	651	499	461	378	317	64
Sec.	1,401	1,090	1,019	782	416	100

In order to arrive at some idea of the extent to which school size extends beyond the minimum size, it is useful to examine Tables 4-1 and 4-2. Based on these data, we might place some estimates on minimum school size. If we use estimates of 300 students and 500 students for minimum elementary and high school size respectively, we find, in examining Table 4-3, that approximately three out of every four students, on the average, attend an elementary or high school which is larger than the estimated minimum sizes.[40] Our hypothesis suggests that to some extent this excessive size is a result of administrative priorities for social control over school operations.

To summarize, we have shown that nonpublic or private schools tend to operate at significantly smaller sizes than do the public schools. The implications of this evidence for educational voucher plans is that we will have about twice as many elementary schools and three to four times as many high schools operating in the private market for education created under a voucher arrangement than are currently operating within the public school system.

VI. - IMPLICATIONS OF THE THEORY AND EVIDENCE ON SCHOOL SIZE FOR EDUCATIONAL VOUCHER PLANS

Two topics will be addressed in this concluding section. First, we will summarize the issue of efficiency in educational markets. Second, we will offer some alternative ways in which school managers might reduce the scale of school operation.

Educational Vouchers and Size

We have determined that there is a negative relationship between a number of educational outcomes and school size, holding other things constant. We have also seen that private schools tend to be smaller than their counterparts in the public sector. Finally, if it is true that the quality of education in private schools tends to be at least as high as the quality of public school education (as has been suggested in the comparison between Roman Catholic and public schools), then schools can operate efficiently and with at least as much effectiveness at a smaller scale than that which characterizes the average existing public school.

In other words, on the grounds of efficiency (i.e., in terms of the relevant school outputs), schools could, and perhaps should, be smaller than they currently are in the public sector.

In theory then, we might expect that schools operating under a voucher system might tend to operate at relatively smaller scales. That is, there exist incentives for each voucher school to attempt to provide the best possible educational services at the lowest possible cost. These incentives result from the pressure of competition and the desire to survive in the market for educational services. Hence, educational managers would tend to operate their schools in a range of school size which is consistent with the minimum unit cost of educational services, and this size is likely to be smaller than the sizes at which public schools currently operate.

It is important to note that the smaller the minimum efficient size of the school, the smaller are the necessary capital requirements for opening a new school. This factor reduces the extent of barriers to entering the marketplace, thereby increasing the possibility of competition within a particular market area. The increase in potential competition correspondingly increases the incentives for efficient operation of the school, and the potential level of consumer choice.

If we can draw the analogy between the behavior of private schools in the current market for education and that of schools operating under vouchers, the evidence we have examined in this paper is consistent with the hypothesis that schools will tend to be smaller under a voucher arrangement. Once again reiterating our own rough estimates, it appears that elementary schools will operate at half the current size of the

average public elementary school, and high schools will operate at about one-fourth to one-third the current size of the average public high school under a voucher arrangement. If these estimates are accurate, then there will be twice as many elementary schools and three to four times as many high schools in the voucher-sponsored marketplace.

Alternative Ways of Reducing School Size

Let us now consider a few ways in which voucher schools might be able to reduce optimum school size. One way to accomplish this is for smaller schools to locate adjacent to one another and to share their facilities. For example, suppose two high schools were located adjacent to one another. The schools would be operated independently of one another and students of each of the schools would carry on their normal activities within their own schools. However, the schools might share common science or laboratory facilities. By sharing the large fixed costs of such facilities, the schools would be able to maintain the required level of cost-effectiveness which each might not be able to maintain on its own at a relatively small size.

A second way in which schools might be able to operate at smaller sizes is for the schools to contract for various specialized services from outside private firms or from government agencies which might offer their services to a number of schools at a time. These firms or agencies would provide those types of services which are currently provided by the local district, county, or state offices of education. For example, these might include such things as the rental of instructional equipment and materials (e.g., science laboratory facilities, films or learning center materials),

performance of accounting services, and performance of consulting services with regard to administrative tasks or educational function which might be too costly for a small school to maintain on a full-time basis for itself.

A final way in which schools can possibly reduce the minimum efficient size is to specialize in specific subject areas while providing all the other aspects of a general education program. For example, a high school may provide a special program in music or science and, thus, draw upon the students with a special interest in the particular area for its student body. Under the present school system, schools are simply expanded until their student bodies are large enough to support and foster a demand for study in as many specialized areas as possible under one roof.

VII. - SUMMARY

There were two issues of importance presented within this paper. First, we discussed the issue of school size within the context of the existing theory of scalar economies. As a result of this discussion we were able to describe expenditures per student (E/S) for the school as a function of the quality of educational services provided by the school and the number of students in the school. Holding the level of quality constant we were able to describe a U-shaped curve between E/S and S (the number of students in the school).

Next we reviewed some studies which had considered the impact of school size upon various aspects of school quality, where school quality

had been defined as some weighted combination of school outputs. The objective of this exercise was to explore the hypothesis of the negative relationship between school size and school quality once the school had reached some minimum scale of operation. After examining the evidence, we found school size to have a negative or no impact upon achievement test scores and to have a negative impact upon a set of affective educational outcomes studied by Barker and Gump.

We then examined some data on differences in school size between public and private schools. We found that on a national level and within the sample of schools from the San Francisco Bay Area, that private schools tended to operate at smaller enrollments than did their public school counterparts. We combined this information with some additional data and evidence on the quality of public versus nonpublic Catholic education, and we concluded tentatively that public schools may in fact be too large to operate at the minimum level of expenditure required for a given level of quality.

The second major issue of importance was the discussion of the implications of the theory and evidence of school size for educational voucher plans. We suggested that pressures of competition would encourage firms to operate within the range of optimal school size. Since the minimum efficient size of a school would be relatively small, we suggested that potential competition would also be a real force in the market because of the relatively low capital requirements and therefore relatively nominal barriers to entry.

The essence of this discussion is that the smaller the size of each individual school in the market for educational services the greater the number of schools, the extent of competition, and, hence, the efficiency

with which educational services will be produced. Furthermore, the greater the number of schools which can supply educational services to the market the greater is the possible variety of choice offered to the consumer of these serivces.

FOOTNOTES

1. See Milton Friedman (1962), pp. 85-107 for a description of his plan. See J.E. Coons et al (1970), pp. 256-68, for a description of the Family Power Equalizing plan. See the volume on Education Vouchers from the Center for the Study of Public Policy for a summary of 7 different voucher schemes including the "Regulated Compensatory" voucher attributed to Jencks.

2. For those not familar with the theoretical affects of competition on efficient allocation of resources, see Paul Samuelson, Economics, "Price Functioning of a 'mixed' Capitalistic Enterprise System" (chapter 3), 6th edition.

3. It could be argued that this definition of market size excludes the possibility of non-graded classrooms in which children attend classes or work at learning centers in open classrooms according to their current levels of ability without regard to chronological age. In this case we could extend the definition to include the number of children, regardless of age, who are eligible or capable of working within the given range of achievement to be defined by the school.

4. There are two other dimensions of market size which are not explicitly accounted for here. One is financial access of students to a particular school. If, for example, the Friedman plan was being employed where parents were allowed to supplement their vouchers with private funds, then obviously some will be better able to afford higher priced schools than others. Hence, students from poorer families will not have the ease of access to these higher priced schools that students from relatively wealthy families have.

   A second dimension of access involves the nature of the educational experience offered by the school. A certain amount of segregation can be achieved through the efforts of particular socioeconomic, religious or political groups to establish schools which cater to the specific philosophies or life styles of these groups. In this way access to the school would be limited to the extent of the specialized appeal of the philosophy.

   Thus, we have these two other dimensions of access to schools which may affect market size of the school.

5. This is not true in the case of the natural monopoly (e.g., public utilities) where unit costs continue to decline due to the spreading of large fixed costs of capital over the increasing level output.

6. Joe S. Bain, (1968), p. 168.

19. I emphasize the phrase "to some extent" because the responsibility for these educational outcomes is clearly not exclusively that of the formal schooling process. Obviously the role of parental guidance should be given no small part in this responsibility. But the apportionment of this responsibility can be left as a matter for debate.

20. Average enrollment per school is derived by dividing total enrollment in public elementary and secondary schools by the total number of schools. The source of these data is Table A, page 4 in Statistics of Local Public School Systems, Fall 1968.

21. The average size for private schools was derived in the same way as that for public schools. The source was the Directory-Nonpublic Elementary and Secondary Day Schools, 1968-69, p. 10.

22. The cities included within this suburban area are Atherton, Belmont, Burlingame, Hillsborough, Los Altos, Los Altos Hills, Menlo Park, Mountain View, Palo Alto, San Carlos, and San Mateo.

23. The formula for the t-statistic is given in equation (1) below:

$$t = \frac{(\bar{X}_1 - \bar{X}_2)\sqrt{\frac{N_1 \cdot N_2}{(N_1+N_2)}}}{\sqrt{\frac{\sum_{i=1}^{N_1}(X_{i1}-\bar{X}_1)^2 + \sum_{j=1}^{N_2}(X_{j2}-\bar{X}_2)^2}{(N_1 + N_2 - 2)}}}$$

X_{i1} = the size of the ith private school

$\bar{X}_1$ = the average size of private schools in the respective sample.

X_{j2} = the size of the jth public school

$\bar{X}_2$ = the average size of public schools in the respective sample.

N_1 = the number of private schools in the sample.

N_2 = the number of public schools in the sample.

See Alexander Mood and Franklin Graybill, (1963) pp. 303-306 for an explanation.

24. These data are taken from an unpublished survey of private pre-schools and day care centers in the San Francisco Bay Area which was completed under the direction of Professor Henry Levin, School of Education, Stanford University.

25. A Report on U.S. Catholic Schools 1970-71, A publication of the Research Department of the National Catholic Education Association, p. 26.

26. Rev. Ernest Bartell, (1971), p. 3.

27. Rev. Ernest Bartell, Costs and Benefits of Catholic Elementary and Secondary Schools, p. 246. These results were taken from tests administered to a group of Catholic pupils in the Diocese of Youngstown, Ohio. "Performance scores on achievement tests represent levels of grade placement based on norms established in a national sample of test results in public school systems."

    Bartell also studied the performance of eighth grade Catholic pupils in San Francisco on standardized tests in reading, language, math, social studies and basic skills. He discovered that on the average, these pupils performed a minimum of 7 months above grade level for all the tests (i.e., 7 months on the reading test, 8 months on the language and mathematics tests, 9 months on social studies test, and 10 months - one full grade level - on the basic skills test). However, these test results were based on norms derived from a national sample of pupils in parochial schools. Hence, it only atests to the quality of San Francisco Catholic schools relative to the population of Catholic schools. It provides us with no information about the relative quality of these San Francisco Catholic schools relative to San Francisco public schools.

28. Ernest Bartell, Costs and Benefits of Catholic Elementary and Secondary Schools, p. 247.

29. James Morrison and Benjamin Hodgkins (Winter 1971)

30. James Morrison and Benjamin Hodgkins, p. 119.

31. A comparison of pupil-teacher ratios between public schools and Catholic schools in San Francisco, San Jose and in the selected suburban area between the two cities is shown below:

	(1969-70) Public School*	(1968-69) Roman Catholic Schools**
San Francisco		
Elementary	25.5	36.4
Secondary	12.5	20.6
San Jose		
Elementary	22.9	36.7
Secondary	15.4	19.4
Suburban Area		
Elementary	22.6	31.6
Secondary	13.8	20.9

*California School District Financial Analysis, 1969-70, Research Bulletin, California Teachers Association #253 Dec. 1970, pp. 161&3.

**Directory-Nonpublic Elementary and Secondary Day Schools

32. There is some evidence of significant, though in some cases diminishing, differences between public and Catholic schools with respect to the level of teacher preparation which effects salary levels. The tables below give some rough indication as to differences in preparation levels.

Public Schools*

Level of Preparation	% of teachers at that level of preparation
Less than BA	2.4%
BA degree (or 4 yrs) but < 5	56.5%
MA (or 5 yrs) but < 6	28.7%
6 yrs college	9.8%
Doc. (or 7 yrs)	2.6%
Total	100.0%

Catholic Schools**

Level of Preparation	% of Teachers at that level of preparation in:	
	Elem. Sch.	Sec. Sch.
Less than BA	26.2%	2.5%
BA	62.2%	54.9%
MA	11.5%	41.8%
Doc.	0.1%	0.8%
Total	100.0%	100.0%
Actually Certified	57.5%	63.8%
Certifiable	23.7%	26.2%
Not Certifiable	18.7%	10.0%
Total	100.0%	100.0%

*25th Biennial Salary Survey of Public-School Professional Personnel, 1970-71, Vol. I., p. 32.

**(on next page)

32. (Continued)

**A Report on U.S. Catholic Schools, 1970-71, p. 20-21. Actually Certified refers to teachers who have teaching Certificates in the respective states. Certifiable refers to those teachers who meet regular state certification requirements but had not actually been certified (did not apply, etc.). Not Certifiable refers to those teachers who did not meet regular state requirements for certification.

33. See Herbert Kiesling (1971) and Henry Levin (1970) for reviews of the literature on educational production.

34. Rev. Ernest Bartell Costs and Benefits of Catholic Elementary and Secondary Schools, p. 66. Average expenditures per student (including the value of contributed services per student) in the Catholic schools are $309 for elementary, $650 for Diocesan and Parish Secondary, and $820 for private Catholic Secondary schools. For public schools these figures were $688 per student for elementary school and $943 per student for secondary school (all figures are current expenditures per student for the 1970-71 school year). For Catholic figures see A Report on U.S. Catholic Schools, 1970-71. The data for public schools was taken from Estimates of School Statistics, 1970-71, Research Report 1970-R15, Research Div., National Education Association, p. 5.

Since current expenditures per pupil were not reported for elementary and secondary schools separately (for public schools), a technique of separation employed by T. Schultz was used (see T. Schultz, "Capital Formation by Education" Journal of Political Economy, Vol. LXVIII, no. 6, (Dec. 1960) pp. 571-583). Schultz develops an index of expenditure on teacher salaries for secondary relative to elementary school teachers. Since teachers salaries are 70 to 80 percent of total expenditures of the school system, he simply applies this index to total expenditures in order to separate figures for elementary and secondary schools.

Let W_i = average salary for type i teacher (i=elementary, high school)

P_i = pupil-teacher ratio for type i education.

$$k = \frac{W_h/P_h}{W_e/P_e} = \text{an index for expenditure for teachers salaries per student in secondary schools compared to elementary school (e).} \qquad \text{(i)}$$

E/S = current expenditures per student for elementary and secondary students combined.

We assume that the relationship of current expenditures per pupil between secondary and elementary schools is the same as the relationship between expenditures for teachers salaries per student, k. Thus, we have

$$E/S = (E_e/S_e)(S_e/S) + (E_h/S_h)(S_h/S) \qquad \text{(ii)}$$

where E_e, E_h = current expenditures for elementary and secondary schools, respectively.

S_i = number of type i pupils (i=e,h).

We assumed above that

$$E_h/S_h = k(E_e/S_e) \qquad \text{(iii)}$$

If we combine equations (i), (ii), and (iii) we can solve for both E_e/S_e and E_h/S_h. Thus, we simply use the values of W_e, W_h, P_e, P_h, S_e, S_h, S and E/S reported in the Estimates of School Statistics to determine our estimates of current expenditures per pupil in elementary and secondary schools separately.

35. Charles E. Bidwell, (1965), p. 1012.

36. Charles E. Bidwell, pp. 976-7.

37. These characteristics are three of the bureaucratic characteristics which Bidwell suggests as descriptive of school systems.

38. For a more complete discussion of the structure of the public school district and its implications for allocation of educational resources see Henry Levin, (1971).

39. Kenneth A. Simon and W. Vance Grant, Digest of Educational Statistics 1969 Edition, U.S. Department of Health, Education, and Welfare, Office of Education, p. 28.

40. James Conant suggests that a high school with a senior class of a minimum of one hundred students (implying a 4 year high school of 400 students) can provide a sufficiently challenging and comprehensive program while using its resources intensively enough to be economical. See James B. Conant, The American High School Today, McGraw-Hill Book Company, Inc. (1959), section IV.

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